## CLAIMS

What is claimed is:

1. A bymixer device that is connectable to a respiratory gas flow conduit in a ventilation circuit used for ventilating a human or veterinary patient, said bymixer device comprising:

a flow divider for dividing the flow of respiratory gas into first and second streams;

a main flow channel through which the first stream flows;

a bypass flow channel through which the second stream flows;

said bypass flow channel comprising a) a flow restrictor that restricts the flow of gas through the bypass flow channel, b) a mixing chamber positioned upstream of the flow restrictor and c) sampling apparatus for sampling respiratory gas from said mixing chamber.

2. A bymixer device according to Claim 1 further comprising:

a flow combiner that is connectable to the main flow channel and the bypass flow channel and operative to combine the first and second streams after they have passed through the main flow channel and bypass flow channel.

3. A bymixer device according to Claim 1 wherein the size of the mixing chamber is variable.

4. A bymixer device according to Claim 3 wherein the mixing chamber is formed at least partially of variable length tubing, said variable length tubing being alternately extendable and contractible, thereby alternately enlarging and diminishing the volume of respiratory gas that may be contained within the mixing chamber.

5. A bymixer device according to Claim 1 wherein the flow restrictor is variable.

6. A bymixer device according to Claim 1 wherein the main flow channel comprises a substantially rigid plastic tube.

7. A bymixer device according to Claim 6 wherein the sampling apparatus is selected from the group consisting of:

a port through which a sample of gas may be removed from the mixing chamber; and

a sensor positioned so as to sample gas within the mixing chamber.

8. A system comprising a bymixer device according to Claim 1 further in combination with a monitoring device that is connected to the sampling apparatus and useable to determine at least one variable in gas sampled from the mixing chamber.

9. A system according to Claim 8 wherein the monitoring device comprises a device useable for performing capnography or calorimetry.

10. A system according to Claim 8 wherein the monitoring device is operative to determine and/or compute at least one variable selected from the group consisting of:

average alveolar $PCO_2$

volume-averaged alveolar $PCO_2$ ($PE_{CO_2}$);

$CO_2$ elimination ($\dot{V}_{CO_2}$);

pulmonary oxygen uptake ($\dot{V}_{O_2}$);

concentration or partial pressure of volatile gases; and

concentration or partial pressure of non-volatile gasses.

11. A system according to Claim 8 further comprising a display apparatus connected to or formed integrally of the monitoring device for displaying at least one variable determined by the monitoring device.

12. A system according to Claim 8 further comprising computing apparatus for computing one or more calculated values using at least one variable determined by the monitoring device.

13. A system according to Claim 12 wherein the computing apparatus is programmable.

14. A system according to Claim 12 wherein the computing apparatus comprises a microprocessor.

15. A system according to Claim 12 wherein the system receives data required for and is equipped to calculations one or more values selected from the group consisting of:

Minute Ventilation ($\dot{V}_E$);

Tidal Volume ($V_T$);

Inspiratory Reserve Volume (IRV);

Expiratory Reserve Volume (ERV);

Total Lung Capacity (TLC);

Functional Residual Capacity (FRC);

Vital Capacity (VC);

Pulmonary Oxygen Uptake Per Breath ($VO_{2,br}$); and

Pulmonary Carbon Dioxide Elimination Per Breath ($VCO_{2,br}$).

16. A ventilation circuit for use in ventilating a human or veterinary patient, said ventilation circuit comprising a) an inspiratory flow conduit that carries a flow of inspiratory respiratory gas for delivery into the patient's lungs, b) an expiratory flow conduit for carrying expired respiratory gas that has been expelled from the patient's lungs and c) a bymixer according to Claim 1 connected to at least one of said inspiratory flow conduit and said expiratory flow conduit.

17. A ventilation circuit according to Claim 16 wherein the ventilation circuit is an open circuit wherein expired respiratory gas is not recycled into the inspiratory flow conduit.

18. A ventilation circuit according to Claim 16 wherein the ventilation circuit is a closed or circle circuit wherein expired respiratory gas is recycled into the inspiratory flow conduit.

19. A ventilation circuit according to Claim 18 further comprising a carbon dioxide absorber for removing at least some carbon dioxide from the expired respiratory gas before it is recycled into the inspiratory flow conduit.

20. A ventilation circuit according to Claim 18, further comprising a fresh gas inflow conduit for combining fresh respiratory gas with recycled expired respiratory gas such that the inspiratory flow conduit carries a mixture of fresh respiratory gas and recycled expired respiratory gas.

21. A ventilation circuit according to Claim 16 wherein the bymixer is connected to the inspiratory flow conduit such that samples of mixed inspiratory respiratory gas may be obtained from the sample port of the bymixer.

22. A ventilation circuit according to Claim 16 wherein the bymixer is connected to the expiratory flow conduit such that samples of mixed expiratory respiratory gas may be obtained from the sample port of the bymixer.

23. A ventilation circuit according to Claim 16 wherein a first bymixer is connected to the inspiratory flow conduit such that samples of mixed inspiratory respiratory gas may be obtained from the sample port of the first bymixer and a second bymixer is connected to the expiratory flow conduit such that samples of

mixed expiratory respiratory gas may be obtained from the sample port of the second bymixer .

24. A ventilation circuit according to Claim 16 further comprising a source of anesthetic gas such that inspiratory respiratory gas that flows through the inspiratory flow conduit includes at least one anesthetic gas.

25. A method for sampling mixed respiratory gas in a ventilation circuit for ventilating the lungs of a human or veterinary patient, said ventilation circuit including at least one inspiratory flow conduit through which inspiratory respiratory gas flows for delivery to the patient's lungs and at least one expiratory flow conduit through which expired respiratory gas flows after having been expelled from the patient's lungs, said method comprising the steps of:

A. providing a bymixer device having i) a flow dividing manifold for dividing a flow of respiratory gas into first and second flow streams, ii) a main flow channel connected to the inflow manifold such that the first flow stream flows through the main flow channel, iii) a bypass flow channel connected to the inflow manifold such that the second flow stream flows through the bypass flow channel, said bypass flow channel comprising a flow-restrictor that partially blocks the flow of respiratory gas through the bypass flow channel and a mixing chamber positioned upstream of the flow restrictor such that mixed respiratory gas will collect in said mixing chamber.

B. attaching the bymixer to either an inspiratory flow conduit or an expiratory flow conduit of the ventilation circuit such that either inspiratory

respiratory gas or expiratory respiratory gas flows through the bypass channel and becomes mixed in the mixing chamber.

26. A method according to Claim 25 further comprising the step of:

C. sampling mixed respiratory gas from the mixing chamber.

27. A method according to Claim 26 wherein Step C comprises withdrawing a sample from the mixing chamber.

28. A method according to Claim 26 wherein Step C comprises positioning a sensor within the mixing chamber and sampling gas within the mixing chamber by way of said sensor.

29. A method according to Claim 26 further comprising the step of:

D. determining at least one variable from mixed respiratory gas sampled in Step C.

30. A method according to Claim 29 wherein Step D comprises performing capnography on mixed respiratory gas sampled in Step C.

31. A method according to Claim 29 wherein Step D comprises performing calorimetry on mixed respiratory gas sampled in Step C.

32. A method according to Claim 29 wherein Step D comprises determining and/or computing at least one variable selected from the group consisting of:

volume-averaged alveolar $PCO_2$ ($PE_{CO_2}$);

pulmonary carbon dioxide elimination ($\dot{V}_{CO_2}$);

pulmonary oxygen uptake ($\dot{V}_{O_2}$);

concentration or partial pressure of volatile gases; and

concentration or partial pressure of non-volitile gasses.

33. A method according to Claim 25 further comprising the step of determining one or more values selected from the group consisting of:

minute ventilation ($\dot{V}_E$);

tidal volume ($V_T$);

Total Lung Capacity (TLC);

Functional Residual Capacity (FRC);

Vital Capacity (VC); and

pulmonary carbon dioxide elimination per breath ($\dot{V}_{CO_2}$,br).

34. A method according to Claim 25 wherein the size of the mixing chamber is variable and wherein the method further comprises the step of:

D. changing the size of the mixing chamber.

35. A method according to Claim 25 wherein the degree of flow restriction caused by the flow restrictor is variable and wherein the method further comprises the step of:

D. varying the degree of flow restriction caused by the flow restrictor to change the flow rate of gas through the mixing chamber.